Celiac disease is one of the most common food intolerances. It is estimated that the disease affects 0.5-2% of European populations. The disease is characterized by a strong intestinal immune response to the dietary protein, contained mainly in cereal products (wheat, barley, rye) - gluten. So far, the only treatment for celiac disease is a strict lifelong gluten-free diet. The disease occurs in people with a certain genetic predisposition, in whom gluten is presented by specific proteins (HLA-DQ2/DQ8) to immune cells - T lymphocytes. In the long term, excessive immune reaction leads to atrophy of intestinal villi and a reduction in the absorption surface of the intestines. It has been shown that gluten modification by the human enzyme - tissue transglutaminase 2 (TG2) increases the recognition of gluten by immune cells in the intestine, leading to a stronger immune reaction. Representatives of this group of enzymes can also be found in the bacterial domain.

In celiac disease patients, the gut microbiota is disturbed, compared to healthy individuals, characterized by higher levels of unfavorable bacteria and lower levels of bacteria with protective properties. It has been suggested that microbial transglutaminases (mTG) secreted by the gut microbiota are potential risk factors for people genetically susceptible to develope celiac disease, because the action of mTG can lead to the formation of highly immunogenic gluten fragments. In addition, mTG are widely used in industrial food processing and are also found in bacterial strains with probiotic properties, the supplementation of which is constantly increasing in the society. Therefore, there are justified concerns about the safety of consuming food products processed with mTG. Over the past four decades, a positive correlation has been observed between increased annual consumption of enzymes used in food processing and an increase in the incidence of celiac disease. However, it is not entirely clear what is the range of mTG diversity? What are the amounts of mTG produced in the intestinal lumen? Does additional intake of mTG with the diet increase the concentrations of these enzymes in the intestinal lumen? and what are the consequences of elevated mTG levels in the body? We also lack information on the ability of these bacterial enzymes to produce active molecules (modified gluten fragments) that may contribute to the activation of the immune system.

The scientific goal of the project is to determine whether bacteria and/or their products present in larger quantities in patients with celiac disease in the gut and/or supplied to the body with the diet can contribute to the development of celiac disease by generating active molecules (modified gluten fragments) with properties that stimulate immune cells. The project plans to identify bacteria producing microbial transglutaminases using biochemical tests. To investigate whether the obtained mTG exhibit properties leading to gluten modification using mass spectrometry techniques. It is also planned to investigate whether the modified gluten fragments affect the activation of the immune system and inflammation in laboratory conditions and using mouse models of celiac disease.

The reasons for the increasing incidence of celiac disease in recent decades are currently unknown. It is very likely that the causes lie in environmental changes. In the case of gluten-induced disease, this indicates changes in infant feeding, dietary habits and/or industrial food processing, but also bacterial infections and food hygiene. Hence, it is very important to characterize the ability of intestinal bacteria and food-associated bacteria to modify gluten. Since mTG and their industrial use in food may potentially increase the recognition of gluten by immune cells, individuals at increased risk of developing the disease may be exposed, ultimately leading to an increase in disease symptoms. However, the identification of environmental risk factors for celiac disease may enable gastroenterologists, public health experts and food safety regulators to reduce the incidence of the disease through patient advice, health policy and/or food hygiene measures.